

We claim:

1. An improved method of introducing a nucleic acid into plant cells comprising providing a whisker cocktail comprising (i) at least one cell, (ii) a multiplicity of whiskers

10 and (iii) at least one nucleic acid, and subjecting said whisker cocktail to a shaking motion of less than 2100 cycles per minute so as to create collisions between said whiskers and said plant cells whereby said nucleic acid is introduced into said plant cells.

15 2. The method according to any of claims 1, 6, 7, 13, 14, 18 including a step of regenerating at least one of said plant cells into a plant comprising said nucleic acid.

20 3. The method according to claim 2 including a step of using the seed or progeny which has an ancestor of the plant in claim 2, wherein said seed or progeny comprise through inheritance the nucleic acid directly or indirectly from the ancestor plant.

25 4. The method according to claim 1 wherein said cycles per minute are less than 1000.

5. The method according to claim 1 wherein said cycles per minute are approximately 768.

30 6. A whisker mediated method for transforming a plant cell, said method comprising:

(a) providing a whisker cocktail comprising: cells, a multiplicity of whiskers and DNA,

(b) contacting said cocktail in at least one vessel adapted to be shaken, wherein said

vessel is capable of retaining at least 16 ml of said cells;

35 (c) placing at least one of such vessels holding the cocktail in means for shaking the cocktail; and,

5 (d) shaking with such shaking means at least one of such vessels wherein said DNA is capable of being inserted into at least one of said cells whereby forming a whisker mediated transformed plant cell.

7. A whisker mediated method for transforming a plant cell capable of being
10 regenerated into a fertile plant, said method comprising:
(a) providing a whisker cocktail comprising: cells, a multiplicity of whiskers and DNA;
(b) shaking such cocktail in at least two of the x axis, y and z axes wherein said DNA is capable of being inserted into at least one of said cells thus forming a whisker
15 mediated transformed plant cell capable of being regenerated into a fertile plant.

20 8. The method according to any of claims 1, 6, 7, 13, 14, 18 including the step of regenerating at least one of said plant cells into a fertile plant.

9. The method according to claim 8 including the step of harvesting seed from the fertile plant.

10. The method according to claim 9 including the steps of planting the seed which form plants and selecting new seed from the plants and repeating the selection steps.

11. The method according to claim 10 including the step of repeating the selection
25 steps of claim 10.

12. The method according to claim 11 including a step of using the seed or progeny which has an ancestor of the plant in claim 11, wherein said seed or progeny comprise through inheritance the nucleic acid directly or indirectly from the ancestor plant.

30 13. A whisker mediated method for transforming a plant cell, said method comprising:

(a) providing a whisker cocktail comprising (i) at least one cell, (ii) a multiplicity of whiskers and (iii) at least one nucleic acid, and

5 (b) shaking such cocktail with means for shaking comprising a axis of rotation, wherein
said shaking means extends such cocktail not less than 1.3 cm radially from said
axis of rotation wherein said DNA is capable of being inserted into at least one of
said cells thus forming a whisker mediated transformed plant cell.

10 14. An improved whisker mediated method for transforming large volumes of plant
cells in each respective whisker mediated shaking step, said method comprising:
(a) providing a whisker cocktail comprising (i) cells, (ii) a multiplicity of whiskers
weighting not less than .032 grams and (iii) at least one nucleic acid;
(b) shaking such cocktail in a single whisker mediated transformation step wherein
15 said DNA is capable of being inserted into said large volumes of plant cells thus forming
whisker mediated transformed plant cells.

20 15. A method according to claim 14 wherein the volume of cells is at least 35 ml.
16. A method according to claim 14 wherein the volume of cells is at least 70 ml.
17. A method according to claim 14 wherein at least a portion of said whisker cocktail
is located in a vessel and said vessel contains not less than 3 ml of cells.
18. A method according to claim 14 wherein the volume of cells is at least 105 ml.

25 19. A whisker mediated method for transforming a plant cell, said method
comprising:
contacting at least one cell with a multiplicity of whiskers and with DNA whereby forming
a whisker cocktail;
shaking such cocktail for at least 1 seconds wherein said DNA is capable of being
inserted into at least one of said cells thus forming a whisker mediated transformed
30 plant cell.

20. A method according to claim 14 wherein the cocktail moves through a nonrandom
pathway in the axes.